Renewable and Sustainable Energy Reviews 40 (2014) 1081–1089

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Assessment of the consciousness levels on renewable energy resources in the Sultanate of Oman

Y. Al Hatmi [a,*], C.S. Tan [b], A. Al Badi [c], Y. Charabi [d]

[a] Department of Electrical and Power Engineering, Institute of Energy Policy and Research, Uniten, Malaysia
[b] Institute of Energy Policy and Research, Uniten, Malaysia
[c] Department of Electrical & Computer Engineering College of Engineering, Sultan Qaboos University, Muscat, Oman
[d] Department of Geography, Sultan Qaboos University, Muscat, Oman

ARTICLE INFO

Article history:
Received 11 March 2014
Received in revised form
15 June 2014
Accepted 5 August 2014

Keywords:
Renewable energy
Questionnaire
Researchers
Electrical companies
Authorities

ABSTRACT

This paper aims to investigate the level of awareness and prevailing attitudes of the Oman government's electrical sectors towards renewable energy. The geographical landscape of the Sultanate of Oman lends itself to energy generation from solar radiation, yet no decisive steps have been taken to initiate relevant projects that will reduce the country's reliance on oil and gas in electricity production. This study is motivated by the need to better understand the obstacles that impede the implementation of renewable energy projects in Oman and the factors that cause delays in project initiation. To this end, we developed a questionnaire with sections intended for three government sectors: research groups, electrical companies and ministries, and regulatory bodies. Results indicate that ministries and regulatory bodies primarily support the increased exploitation of fossil fuels—a core reason for the slow adoption of renewable energy sources. Moreover, 82% of the respondents place priority on natural gas for use in power plants and more than 19% encourage the implementation of energy efficiency standards. All respondents consider renewable energy a viable future energy option and generally agree that the government should promote renewable energy and support relevant pilot projects. This study highlights the importance of immediately shifting to renewable energy and encouraging its development; a move necessary to alleviate the environmental risk posed by the use of fossil fuel-based energy.

Contents

1. Introduction

In Oman, growing concerns over global environmental issues have emerged, giving rise to a consensus on the criticality of implementing renewable energy (RE) projects as part of the

* Corresponding author. Tel.: +96 892870708.
E-mail addresses: alhatmi2012@gmail.com (Y. Al Hatmi), ChingSin@uniten.edu.my (C.S. Tan), albadi@squ.edu.om (A. Al Badi), yassine@squ.edu.om (Y. Charabi).

http://dx.doi.org/10.1016/j.rser.2014.08.012
1364-0321/

national strategy to reduce carbon emissions and ensure energy security. To date, the current structure of Oman's energy sector and the policy instruments designed to support energy generation from renewable sources remain weak and incapable of facilitating relevant programmes. Another problem that characterises the country's energy landscape is the absence of clear targets for the shift to RE.

In 2007, the Authority for Electricity Regulation (AER) announced that it would carry out a study in the field of RE with the purpose of providing an overview of RE sources in the Sultanate of Oman and ascertaining the potential of these resources for electricity production. The study assessed the available RE technologies and their technical suitability for use in the Sultanate and summarised the most important RE sources in Oman, solar energy and wind energy, as these are the most abundant resources in the Sultanate. The study, published in 2008, recommended the implementation of pilot projects and a feasibility study for electrical production using solar energy of 100–200 MW.

AER's study concluded that the level of solar energy density in Oman is among the highest in the world. There is a significant opportunity to develop solar energy resources throughout Oman and provide sufficient electricity to meet all of Oman's domestic electricity requirements. High solar energy density is available in all regions of Oman, and it significantly increases during the summer season, which coincides with the peak periods of electricity demand in Oman. The areas of highest density are dessert areas, while the coastal area in the southern part of Oman has the lowest density [1].

In addition, Gastli and Charabi [2] found that the majority of the land in Oman receives solar radiation ranging between 5500–6000 W h/m^2/day in July and 2500–3000 W h/m^2/day in January.

Most of the member countries of the Gulf Corporation Council (GCC), of which Oman is also a constituent, have put in place efforts towards a gradual increase – over a 40-year period – in the proportion of electricity produced via RE. This strategy is expected to reduce dependence on oil and gas and improve energy security. Member countries have also launched initiatives to measure the acceptance and awareness of people regarding the conversion to renewable sources. These efforts, which include administering questionnaires and holding interviews, provide a clear picture of energy trends and enable correction measures that keep nations on track in terms of sustainable energy planning. Many countries, such as China, Germany, Spain and the United States, have also investigated the level of awareness and prevailing attitudes of people towards RE, related environmental issues and security in electricity production. They use different measurement techniques and employ the results as bases for drawing secure energy plans that can be carried out in accordance with specific timeframes.

Many research and informative studies were conducted using the assessment of RE awareness scale. Eshchanov et al. [3] investigated decision makers' perceptions on the introduction of RE sources in the residential sectors of Uzbekistan. The authors administered questionnaires designed to look into public awareness of RE resources; such awareness is regarded as an essential factor in creating favourable preconditions for the application of RE. The findings show that the factors most conducive to awareness building are the acquisition of sufficient knowledge, followed by the availability of qualified technical personnel. Liu et al. [4] developed an analytical framework based on the theory of planned behaviour. (They used this model to examine local social acceptance, determined through a questionnaire survey administered in Shandong City. The authors concluded that enhancing the knowledge and understanding of RE is conductive to engendering public acceptance of RE deployment.

West et al. [5] used cultural theory to examine environmental debates, thereby acquiring an in-depth picture of respondents' general worldviews and specific opinions on RE. The findings serve as a reference for exploring the ways through which government policies on RE may be tailored towards engendering greater public support and participation. Musall and Kuik [6] used 'not in my backyard' (NIMBY) concepts to elucidate the assumed tension between general public support for RE sources and local resistance towards the construction of specific sites. Through a questionnaire distributed in southeast Germany, the authors found increased positivity towards RE. Kaldellis et al. [7] distributed a three-part questionnaire to a representative sample of local inhabitants. The authors assessed the levels of social acceptance for selected RE source (RES) technologies (wind, small-scale hydro and photovoltaic technologies) in a representative region of southern Greece. The survey revealed a high level of acceptance for RE application.

Slattery et al. [8] explored public opposition to wind energy in two of the most important states for wind energy development: Texas and Iowa. The results of their postal and online questionnaire survey identified understanding public reactions to large-scale wind energy developments as a prerequisite to more widespread use of RE resources. The researchers found a high level of public support for wind energy. Aslani et al. [9] studied the primary criteria for private sector participation in RE investment in Iran. They divided the study into qualitative and quantitative phases. For the qualitative phase, the authors designed a questionnaire to identify the factors that drive investment in electricity generation from RE. For the second phase, they conducted a survey on the prioritisation of the criteria derived during the first phase. The Sultanate of Oman has significant potential for solar energy. Despite these huge resources, the applications are limited to street lighting and telephones in remote areas. In addition, the Sultanate of Oman has no targets or strategies related to the promotion and deployment of RE in the foreseeable future, which is not only questionable, but also increases the importance of this study.

In light of the importance of renewable and sustainable energy in the Sultanate of Oman, this paper discusses from a policy perspective the RE awareness scale that questions the extent to which stakeholders are aware of the importance of RE integration in the energy mix. The aim of this paper is to enhance the policymakers' consciousness of RE resources using a consultative approach based on a questionnaire.

2. Incentives for, and barriers to, renewable deployment in Oman

RE technologies possess many long-term benefits that are often overlooked. These benefits include energy security, job creation, business opportunities, sustainable development and the prevention of global warming [10].

Advancing RE development is an effective approach for addressing energy security and climate change. Currently, the U.S., Japan, Brazil and other countries have listed the development of RE as an important strategy for the future [11]. Most research in Brazil on RE policy evolution is related to the evolution of biomass energy policies, while research in Russian RE policy evolution is insufficient and limited to policies on the diffusion and transfer of RE technologies. In China, research is focused on two aspects: assessing the effect of implementation based on the type of policy and analysing RE evolution policies according to energy types [12].

RE development is dependent on political support. As long as RE is not financially and economically competitive in the liberalised market, there is a need for political support. However, this energy is expected to become progressively cheaper in the near future. Oman and the Gulf Community Countries (GCC) region lack accurate data and information about the potential use of RE. This also constitutes a barrier to development in this sector.

A positive investment climate, strong property rights and low tax regimes, with established participation in the power sector from leading international firms, will certainly provide more incentives for RE applications in the country. It is important to receive non-RE policy support. In addition, laws governing power generation regulation shall provide more flexibility and incentives for RE. For instance, the government needs to develop policies to support investors in large-scale solar plants and increase market opportunities for small-scale solar photovoltaic applications.

The government of Oman officially began developing policies on RE in 2008, but RE is still unable to compete with fossil energy and its development depends upon the government's support. The Omani government has yet to stipulate principles and polices to encourage and develop RE.

The policy development and RE status in Oman has made slow progress because there are no clear plans for the future of energy in Oman; there is no strategic plan for RE, nor is there a clear target. There are many reasons behind this:

2.1. Lack of coordination and consistency in policy

Since the first study by Petroleum Development Oman (PDO) in 2000 [13], no progress has been made, and the only study carried out since then was in 2008 by the AER [1]. However, Oman has been slow in implementing the recommendations of the 2008 study because many sectors are responsible for Oman's RE business including PDO, the Authority of Electricity and Water, the AER, Oman Power and Water Procurement and the RAECO, making it difficult to provide consistent energy policies. Furthermore, energy policies in different fields lack coordination, making it difficult to form an effective long-term system to support sustainable RE development.

2.2. No encouragement for RE

The government provides subsidies for fossil energy but does not support RE. A research task could be commissioned to establish the locations and strengths of local wind and solar resources in detail. A task force or forum might create a prestigious body by bringing together the experience and ability to provide a powerful initiative through which Oman would be able to develop its own RE resources and gain international recognition in this growing world business sector.

2.3. No financing system for RE projects

Small initial order sizes, novel equipment and the small number of units to maintain result in a high initial unit cost of equipment and maintenance. The industry could be kick started with funding for the necessary equipment, working capital and initial overheads. However, experienced management would be required.

2.4. Inadequate investment in technical research and development for RE

RE is a technique-intensive and fund-intensive industry. By the end of 2011, there had been no investment in RE allocated in the budget. A training programme for all levels of design and operation could be established to focus on the operation and support of immediately deployable technologies (of small-scale PV and wind-powered water pumping). This programme might then be expanded to provide the research, development and demonstration capabilities needed to support a developing business sector. This design and development capability might also be applied to provide a demonstration and testing service for international manufacturers.

3. Approach and methodology

Considerable technical research in Oman covers solar and wind energy, with such body of research emphasising Oman's energy generating-conducive environment; that is, Oman is characterised by geographical conditions that most strongly lend themselves to solar energy exploitation. The country's wind energy prospects are also promising. Despite these favourable features, no progress has been made and no clear plans have been formulated. To determine the factors responsible for such slow development, this study proposes the following hypotheses to be explored through questionnaire administration:

1. As the Oman government does not consider RE a priority, actions aimed at exploiting this energy source have been delayed.
2. The government regards RE as cost-ineffective in the short term, but may consider it a viable option in the long term.
3. Opportunities to tap RES are maximised because of the negative environmental, economic and social effects of the currently used fossil fuel energy.
4. The search for new energy sources is prompted by the insufficiency of the current energy supply in providing for necessary electricity needs. This inadequacy stems from the steady increase in customers.
5. Solar energy will be the second most extensively tapped source after fossil fuel energy in the production of electricity in the Sultanate of Oman.
6. The government will immediately start pursuing the implementation of pilot projects and developing laws that encourage the use of RE, aiming for a clearly stated rate of growth for this sector.
7. Despite the importance of the Al Duqm strategic area and the plans that the government is looking forward to from this region in 2020, the parties involved will continue to be impeded by an unclear vision of the actual requirements for electric power sources in this region.

Questionnaires were distributed to decision makers in energy ministries, such as the Ministry of Oil and Gas, regulatory institutions, such as the Authority of Public Electricity and Water, and organisations and companies in the energy sector of Oman. These respondents are therefore classified into three groups: energy ministries and regulatory bodies, electric companies and research groups.

4. Results and discussion

Out of 300 equally distributed questionnaires (ministries and regulatory bodies = 100, electrical power companies = 100 and

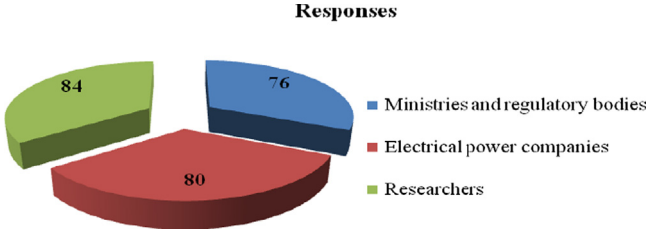

Fig. 1. Respondent categories.

research groups = 100), 240 completed questionnaires were returned. Fig. 1 shows that the highest number of responses was received from the researchers who returned 84% of their questionnaires, followed by electrical power companies who returned 80%. This result indicates that research personnel (professors) welcome the idea of providing students with support information and documentation.

Table 1
Results of ANOVA for cheaper energy resources in the short and long term.

		Sum of Squares	Df	Mean Square	*F*	Sig.
Natural Gas Cheap in short term	Between Groups	1.069	2	.534	11.192	.000
	Within Groups	11.221	235	.048		
	Total	12.290	237			
RE cheap in long term	Between Groups	8.496	2	4.248	34.639	.000
	Within Groups	36.421	297	.123		
	Total	44.917	299			

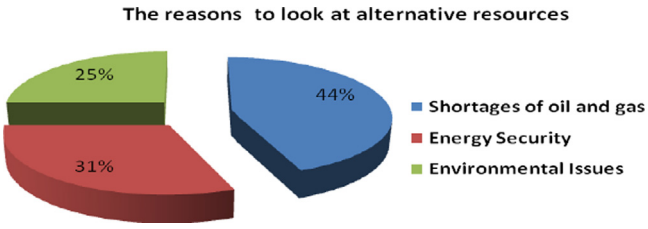

Fig. 2. Drivers of the search for RE.

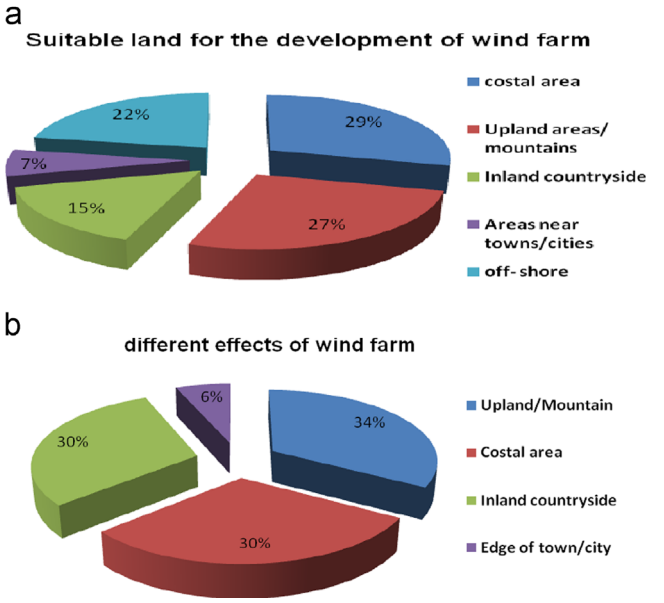

Fig. 4. Wind farm effects and development. a. Suitable land for the development of wind farms. b. Different effects of wind farms on landscape.

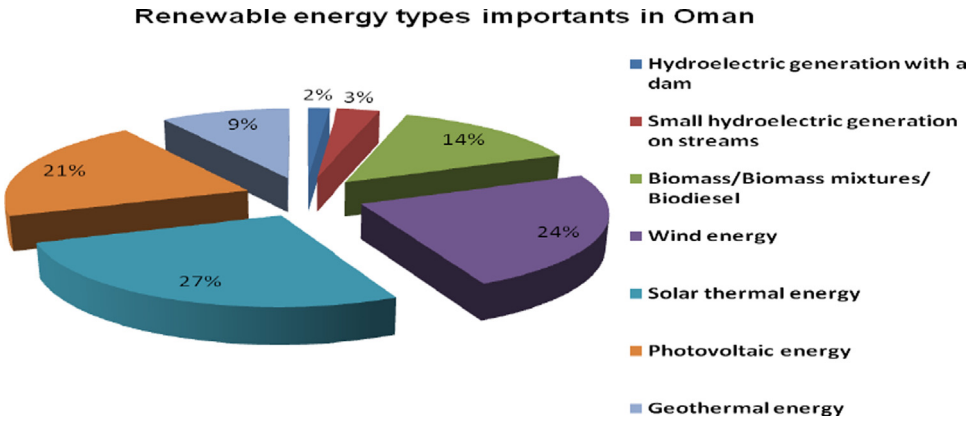

Fig. 3. Important types of RE.

Table 2
Results of ANOVA for the priority of future energy needs.

		Sum of squares	Df	Mean square	*F*	Sig.
Nuclear power plants	Between groups	.000	2	.000		
	Within groups	.000	237	.000		
	Total	.000	239			
RE	Between groups	2.126	2	1.063	11.265	.000
	Within groups	28.021	297	.094		
	Total	30.147	299			
Natural Gas	Between groups	46.784	2	23.392	335.275	.000
	Within groups	19.326	277	.070		
	Total	66.111	279			
Coal Fired	Between groups	33.333	2	16.667	.	.
	Within groups	.000	237	.000		
	Total	33.333	239			
Shortage of Gas prompting search for other resources	Between groups	116.871	2	58.435	178.243	.000
	Within groups	90.484	276	.328		
	Total	207.355	278			

All respondents consider power plants relying on RE resources, such as solar or wind energy, as the top priority and 82% deem natural gas power plants as priority agenda items. However, these respondents believe that the implementation of RE projects would be difficult in the short term because such sources are more expensive than gas and diesel. This finding supports Hypothesis 2.

The respondents identified numerous effects of energy planning, including financial, economic, security and environmental effects; they believe these should be carefully considered in the selection of energy sources. Of these effects, the respondents consider social issues the most crucial, because alternative energy would translate into benefits such as the improvement of people's health and of their surrounding environment, the transfer of knowledge and technology and the distribution of wealth.

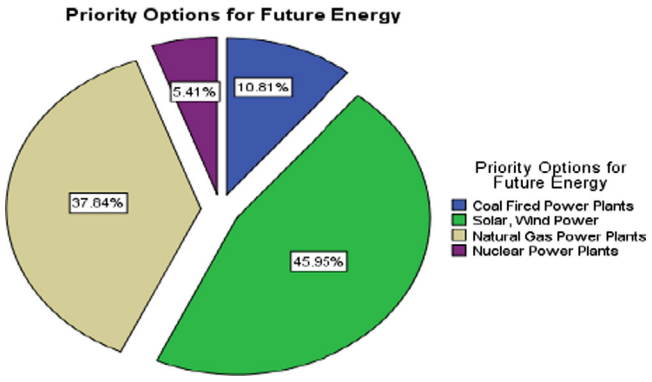

Fig. 5. Priority options for future energy development in Oman.

Table 1 shows the available energy choices for Oman as it develops its energy sector. Out of the respondents, 88.2% are in favour of encouraging energy efficiency and 56% prefer the implementation of energy efficiency standards and regulations. Additionally, 53% positively regard the exploration of more fossil fuel sources in conjunction with developing RE resources. These results support Hypothesis 3.

Ministries and regulatory bodies advocate the increased exploitation of fossil fuels, but simultaneously support energy efficiency and the implementation of standards and regulations. The researchers favour the development of RE sources and taxation policies. The electrical companies are highly supportive of energy efficiency, but exhibit neither favourable nor unfavourable attitudes towards RE development.

All respondents agree that the government should look into alternative energy resources for many reasons, which can be categorised into three categories: the shortage of oil and gas, energy security and environmental issues (Fig. 2). Specifically, the

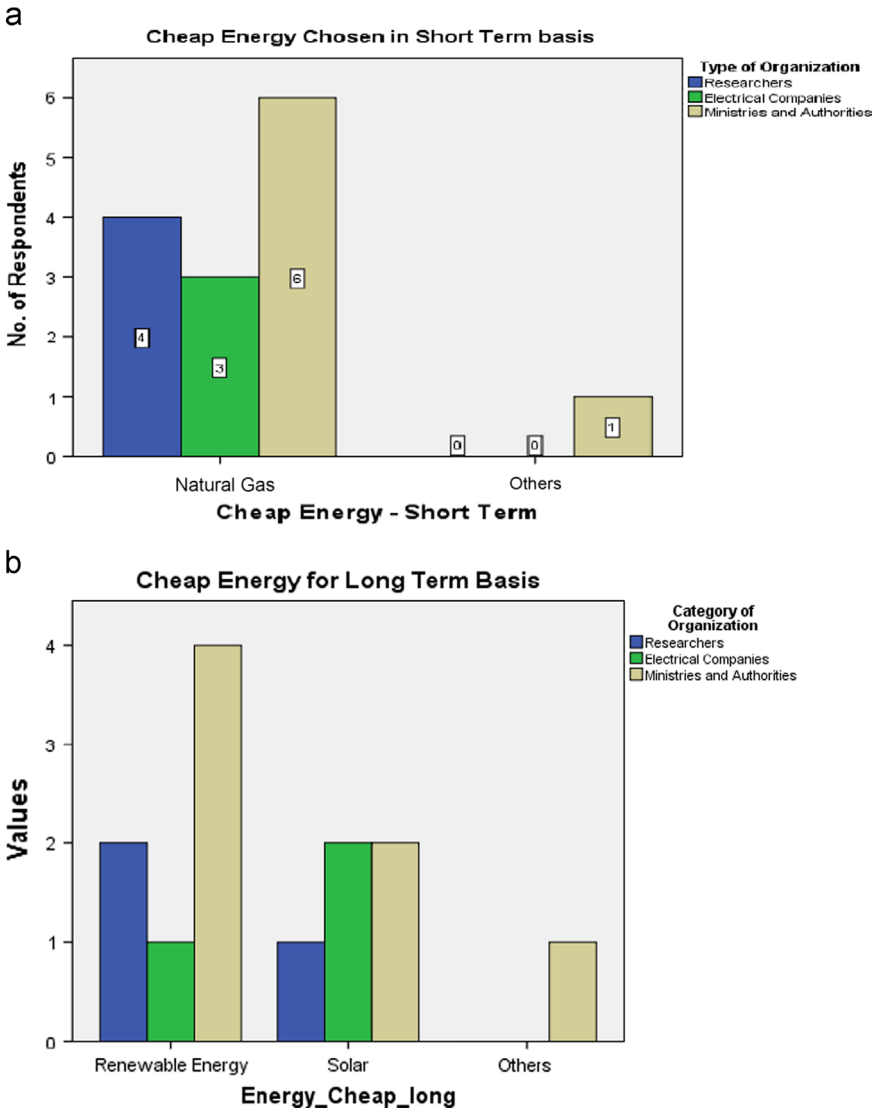

Fig. 6. RE from the perspective of decision makers. a. Cheap energy on a short-term basis. b. Cheap energy on a long-term basis.

respondents regard the shortage of oil and gas (44%) and energy security (31%) as the two main motivations for RE exploration. This finding does not support Hypothesis 3.

When the respondents were asked about their level of interest in RE, 71% identified themselves as environmentally conscious and familiar with RE technologies and their benefits, while 29% admitted to having limited familiarity with such innovations and their advantages. Moreover, most of the respondents (78%) strongly agree that one or more RE projects carried out in Oman will positively contribute to the awareness of RE; a few (7%) raised concerns over negative contributions. Around 82% view the use of RE for electrical production as crucial to their country.

Fig. 3 shows that 27% of the respondents deem solar thermal energy essential for producing electrical power in Oman (supporting Hypothesis 5); 24% regard wind energy, and 21% consider photovoltaic technology, as highly important sources. Respectively, 2% and 3% of the respondents consider hydroelectric generation with dams and small-scale hydroelectric generation plants powered by streams less important alternatives. Table 2 shows that the results do not support Hypotheses 1, as indicated by 81.2% of the respondents highlighting the cruciality of RE as a means of producing electrical power.

All respondents stated that the government should promote RE and support pilot demonstration projects for every type of corresponding technology. In addition, the government should ensure that information on RE technologies is included in secondary and post-secondary education curricula and public documents. All respondents indicated that all involved parties should share the responsibility of promoting the use of RE; these parties include the government, universities and research institutions, the private sector and electrical utility companies. This result supports Hypotheses 6.

The respondents stated that using RE technologies would enable electric utility companies to save on energy bills, reduce environmental degradation and decrease reliance on imported oil and natural gas. RE is also perceived as beneficial to the economy. Fig. 4a shows that coastal areas and upland areas/mountains are the most suitable locations for the construction of wind farms, as indicated by 29% and 27% of the respondents, respectively. These participants believe that building wind farms at locations farther than the edge of towns or cities is a good approach to avoiding the negative effects of such facilities (Fig. 4b). This finding supports Hypothesis 5.

As Fig. 5 shows, priority is nearly equally distributed between RES options and natural gas. Moreover, decision makers do not perceive the short-term application of RES as a special requirement (Fig. 6a). In the long term, however, the attitudes of the government electrical sectors exhibit little difference in preference for gas and RES (Fig. 6b), therefore supporting Hypotheses 1 and 2. Moreover, the government has not formulated a progress plan, indicating its low commitment to RES implementation and pilot project execution.

When asked about the main driver of the search for RES (Hypothesis 3) (Fig. 7), 27.27% of respondents stated that RES does not exert social effects. In terms of the environmental and economic effects, however, the respondents exhibit near agreement.

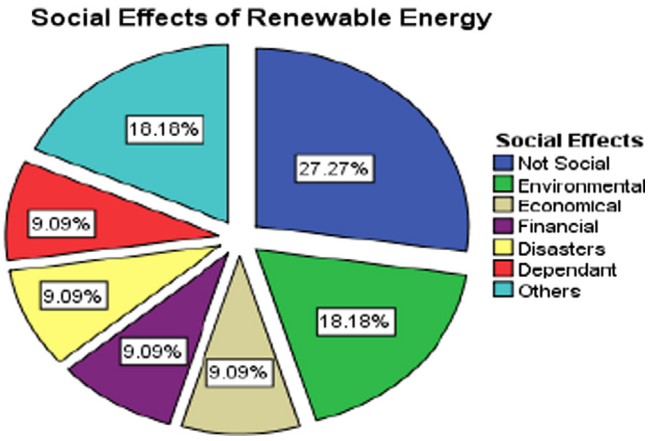

Fig. 7. Social effects of RE.

5. Data analysis using ANOVA technique

Analysis of variance (ANOVA) is a hypothesis testing technique used to test the equality of two or more treatment effects by examining the variance of samples. To reveal the relationships among the questionnaire results, the t-test and ANOVA were used. The t-test is an analytical method that compares the averages of two groups and determines whether a statistically significant difference exists. If more than two groups are being compared, the ANOVA is used to analyse how the independent variables interact and what effect these interactions have on the dependent variable. In this study, we used the t-test to compare the averages of the respondents based on assumed and unassumed equal variance. We also determined whether the differences are statically significant. Some responses exhibit high variances, having

Table 3
Results of ANOVA for the reasons behind looking for RE sources.

		Sum of squares	df	Mean square	*F*	Sig.
Economical and Environmental	Between Groups	63.937	2	31.969	15.732	.000
	Within Groups	339.363	167	2.032		
	Total	403.300	169			
Environmental Impact	Between Groups	14.189	2	7.095	28.829	.000
	Within Groups	63.000	256	.246		
	Total	77.189	258			
Economic Impact	Between Groups	.000	2	.000	.	.
	Within Groups	.000	256	.000		
	Total	.000	258			
Clean Energy	Between Groups	7.797	2	3.898	28.378	.000
	Within Groups	40.800	297	.137		
	Total	48.597	299			

confidence level differences of 0.965 and 0.165; this difference appears to be huge, but other responses indicate similarity and a difference of less than 1. These findings support Hypotheses 2 (Table 1), 6 and 7. We also found a meaningful difference in the replies to questions based on the cheaper energy sources in the short and long term (Table 1). Replies to the question: 'Which energy resource is cheaper in the short term and the long term?' resulted in an F-value of 11% for natural gas in the short term and 35% for RE in long term, which satisfied hypotheses 2. There was a meaningful difference regarding the priority of future energy needs in reference to the question: 'To satisfy the future energy needs of your country, what options should be given priority?' (Table 2). Table 3 shows that the results of ANOVA regarding the reasons to look for RE resources yielded meaningful differences from which we can conclude that as environmental, economic and social impacts increase, the opportunities to tap RE sources are maximised.

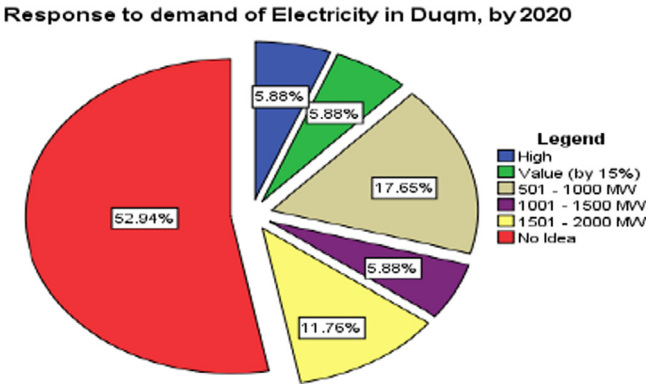

Fig. 8. Respondents' knowledge of electricity demands in 2010.

Fig. 8 shows the respondents' knowledge of the electricity demands of the Al Duqm area in 2010. The participants appear to have minimal understanding of such demands, a result that supports Hypothesis 7.

Questionnaires were administered to the Oman government's electrical sectors to measure their responses to the renewable energy field. The respondents were divided into three categories. The first comprises policy and decision makers, i.e. ministries and regulatory bodies; the second category consists of parties involved in economic and implementation, that is, electrical power companies; and the third comprises the technical group, researchers. The ministries and regulatory bodies and electrical power companies do not view RE as a priority—a perspective that has caused delays in the development of this energy sector (Hypothesis 1). By contrast, the researchers deem this field a priority. Such discordance has given rise to gaps in policies and implementation.

The government views RE as an expensive endeavour in the short term, but considers it a feasible long-term option (Hypotheses 2 and 5). The respondents pointed to the environmental, economic and social effects of fossil fuel energy as the primary drivers of the search for alternative energy sources (Hypothesis 3). Another determinant of the search for RES is the inadequacy of

Table 4
Results of ANOVA used to examine the insufficiency of the current energy supply.

		Sum of squares	df	Mean square	*F*	Sig.
The exploration of more fossil fuels	Between groups	2.479	2	1.239	5.087	.007
	Within groups	72.358	297	.244		
	Total	74.837	299			
Implementation of standards and regulations	Between groups	12.014	2	6.007	19.909	.000
	Within groups	85.087	282	.302		
	Total	97.102	284			
To encourage energy efficiency	Between groups	2.597	2	1.298	11.756	.000
	Within Groups	32.800	297	.110		
	Total	35.397	299			
Development of nuclear power	Between Groups	55.849	2	27.925	23.449	.000
	Within Groups	312.000	262	1.191		
	Total	367.849	264			
Development of RES	Between Groups	36.326	2	18.163	25.111	.000
	Within Groups	214.821	297	.723		
	Total	251.147	299			
Using taxation policy to encourage energy efficiency	Between Groups	73.996	2	36.998	46.125	.000
	Within Groups	226.200	282	.802		
	Total	300.196	284			
Continuing to use oil and gas	Between Groups	2.429	2	1.214	2.374	.095
	Within Groups	151.958	297	.512		
	Total	154.387	299			

Table 5
Results of ANOVA for RE projects making a positive contribution to RE awareness.

		Sum of squares	df	Mean Square	*F*	Sig.
Strongly agree	Between Groups	7.987	2	3.993	28.787	.000
	Within Groups	41.200	297	.139		
	Total	49.187	299			
The government should support pilot projects	Between Groups	9.371	2	4.686	27.048	.000
	Within Groups	49.200	284	.173		
	Total	58.571	286			

current energy supply in meeting the electricity demands—a problem that originates primarily from the steady increase in number of customers, as shown in Table 4 (Hypothesis 4).

All respondents believe in identifying alternatives to fossil fuel resources for electrical power production; however, the ministries and regulatory bodies remain unconfident in an immediate implementation of pilot projects and development of laws that encourage the use of RE. This reluctance is attributed to the belief that the shortage in fossil fuels can be compensated for by either GCC electrical networks or other sources, such as coal and nuclear energy, as shown in Table 5 (Hypothesis 6).

The results show a huge gap in knowledge transfer amongst the electrical power companies, researchers and ministries, particularly in relation to plans for the Al Duqm free zone areas. To date, no clear programme on electrical power sources in this area has been formulated. The only initiative in place is the plan of the Ministry of Oil and Gas to construct a gas line from the desert to Al Duqm, a project that is expected to increase gas shortage and

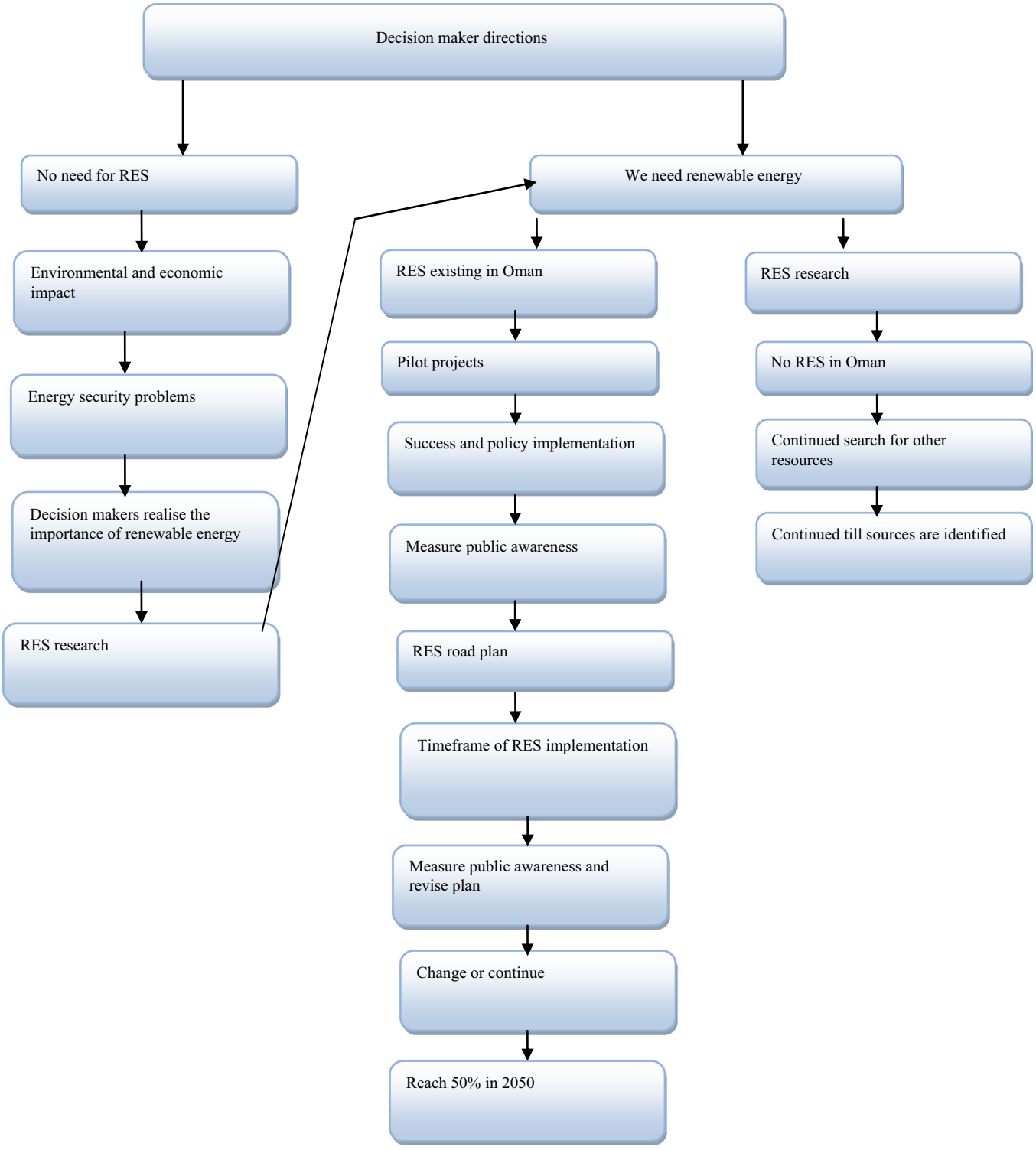

Fig. 9. Suggested plans for the future of the electricity supply in Oman.

diminish energy security in the area. The Al Duqm free zone areas require around 100 MW of energy by the end of 2020 (Hypothesis 7).

6. Conclusion

Based on the information collected in this study, we have produced a process to enhance and accelerate RE in Oman (Fig. 9), which we recommend the Oman government follow for RE initiatives to succeed. This approach will direct the decision maker to elevate RE as the principal energy source for electricity production in Oman. This strategy is also expected to guarantee the country's energy security. While the government of the last 10 years has recognised the need for RE from environmental, economical and securing perspectives, they need to look for RE resources in Oman and implement many pilot projects. Furthermore, the plan should consider doing the following:

- Issue renewable energy authority.
- Set a strategic target for RE.
- Provide patronage and support from the highest level.
- Enlarge investment in research and development.
- Build a suitable demonstration and marketing programme.
- Construct a market investment and financing system.
- Develop process management and ensure effective functioning of policies.
- Select economically and commercially viable technologies for deployment
- Develop skill bases to provide operating support and a science and technology feed to the industry.
- Set up a viable commercial framework within which RE installation can operate as business assets.
- Form a collaboration between the many authorities and bodies which have knowledge and involvement in RE issues.

References

[1] Authority of Electrical Regulation, Oman. RE resources in Oman; 2008. ⟨http://aer-oman.org⟩.
[2] Al-Yahyai S, Charabi Y, Gastli A, Al-Alawi S. Assessment of wind energy potential locations in Oman using data from existing weather stations. Renewable Sustainable Energy Rev 2010;14:1428–36.
[3] Bahtiyor R, Eshchanove Mona, Grinwis Plaat Stultjes, Rusumboy A. Prospects of renewable energy penetration in Usbekistan: perception of the Khorezmian people. Renewable Sustainable Energy Rev 2013;21:789–97.
[4] Wenling Liu, Can Wang, Moi APJ. Rural public acceptance of renewable energy deployment: the case study of Shandong in China. Appl Energy 2013;102:1187–96.
[5] West J, Bailey I, Winter M. Renewable energy policy and public perceptions of renewable energy: a cultural theory approach. Energy Policy 2010;38:5739–48.
[6] Musall FB, Kuik O. Local acceptance of renewable energy: a case study from southeast Germany. Energy Policy 2011;39:3252–60.
[7] Kaldellis JK, Kapsali M, Katsano E. Renewable energy applications in Greece—What is the public attitude? Energy Policy 2012;42:37–48.
[8] Slattery MC, Johnson BL, Swofford JA, Pasqualetti MJ. The predominance of economic development in the support for large-scale wind farms in the U.S. Great Plains. Renewable Sustainable Energy Rev 2012;16:3690–701.
[9] Aslani A, Naaranoja M, Zakeri B. The prime criteria for private sector participation in renewable energy investment in the Middle East (case study: Iran). Renewable Sustainable Energy Rev 2012;16:1977–87.
[10] Huiming Z, Lianshui L, Jie C, Mengnan Z, Qing W. Comparison of renewable energy policy evolution among the BRICs. Renewable Sustainable Energy Rev 2011. RSER-1465. 10.1016/j.rser.2011.07.063.
[11] Martin NJ, Rice JL. Developing renewable energy supply in Queensland, Australia: a study of the barriers, targets, policies and actions. Renewable Energy 2012:1–9. http://dx.doi.org/10.1016/j_renene.2012.01.006.
[12] Yiping F. Economic welfare impacts from renewable energy consumption: the China experience. Renewable Sustainable Energy Rev 2011;15:5120–8.
[13] Buckley JR, Holmes EB. Oman renewable energy for sustainable development, Sustainable Energy Marketing Company: Oman's planning Vision 2020. PDO executive summary 2000.